PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: DAVID PATRICK MAGEE, et al.
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Examiner:	: Alexander Jamal
Title	: **SIMPLIFIED NOISE ESTIMATION AND/OR BEAMFORMING FOR WIRELESS COMMUNICATIONS**

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AMENDED APPEAL BRIEF

Sir:

In response to the Notification of Non-Compliant Appeal Brief dated October 5, 2007, and in accordance with Appellant's Appeal Brief filed on September 17, 2007, Appellant presents this Amended Appeal Brief to replace the previously filed Appeal Brief.

I. <u>TABLE OF CONTENTS</u>

II. REAL PARTY IN INTEREST

The real party in interest is Texas Instruments Incorporated as evidenced by the Assignment dated October 18, 2001.

III. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

IV. STATUS OF CLAIMS

Claims 54-74 which are attached in Appendix A, are currently pending in this application. Claims 54, 56, 57, 59, 60, 62, 63, 65, 67, 68, and 70-74 have been rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,795,409 to Youssefmir (hereinafter, "Youssefmir"). Claims 55, 58, 61 64, 66 and 69 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Youssefmir, as applied to claims 54, 60 and 65, further in view of U.S. Patent No. 6,006,110 to Raleigh (hereinafter, "Raleigh"). Claims 1-53 have been cancelled. The rejection of claims 54-74 is hereby being appealed.

V. STATUS OF AMENDMENTS

A Final Office Action (hereinafter, "Final Action") was issued for the present application on April 19, 2007. No amendments were made to the claims after the Final Action.

VI. SUMMARY OF THE CLAIMED SUBJECT MATTER

A. Claim 54

One aspect of the present invention, as recited in claim 54, is directed to a method (See FIG. 8) for computing beamforming for signals in a communication system (100 in FIG. 4) (See page 20, lines 13-14). The method includes receiving a signal having a plurality of tones over a communication channel (page 5, lines 12-14), some of the plurality of tones being of a first type and some of the plurality of tones being of a second type (See page 7, lines 11-17; see also FIGS. 2 and 3 for examples of tones). Channel estimation is performed (channel estimator 126 of FIG. 4) on the received signal to provide a channel estimate of the communication channel (See FIG. 4, page 10, lines 2-10; and see FIG. 8, page 21, lines 7-10). The method also includes estimating noise (noise estimator 132 of FIG. 4) on the received signal for each of a plurality of the first type of tones to provide a corresponding noise estimate for each of the plurality of the first type of tones (See page 11, lines 2-19; see also block 500 of FIG. 8, and page 20, lines 15-18, and FIG. 7). Beamforming is computed (beamformer 140 of FIG. 4) for at least one tone of a plurality of the second type of tones based on the channel estimate and based on the noise estimate of at least one of the plurality of the first type of tones that is nearest the at least one tone of the plurality of the second type of tones in the received signal (See page 11, lines 20-27; and page 21, lines 3-7).

B. Claim 55

Claim 55 is directed to the method according to claim 54, wherein the estimating noise further comprises computing a first indication of difference between a first one of the first type of tones in one burst relative to the first one of the first type of tones in a preceding burst (See noise vector function 206 and description at page 13, lines 13-17). A second indication of variance and correlation of the first indication is computed (See covariance function 210 of FIG. 5, page 14, lines 14-15, and lines 26-27). The second

indication is averaged over time (time averager 212 of FIG. 5) to provide an average indication of noise that defines the noise estimate for at least one of the plurality of the first type of tones (page 15, lines 1-17).

C. Claim 56

Claim 56 is directed to the method according to claim 54, wherein the received signal is a multi-carrier signal (page 6, lines 12-26), the first type of tones are training tones, and the second type of tones are data tones (See page 10, lines 11-15; see also examples of FIGS. 2 and 3).

D. Claim 57

Claim 57 is directed to a method according to claim 54, which further comprises indexing the plurality of the first type of tones (training tone index block 208 of FIG. 5) and indexing the plurality of the second type of tones (data tone index block 220 of FIG. 5). At least one of the plurality of the first type of indexed tones that is nearest a given indexed second type of tone in the received signal is selected (See nearest neighbor function 216 of FIG. 5, and page 15, lines 17-24; see also page 11, lines 26-27, and page 20, line 30, to page 21, line 1). The beamforming being computed (beamformer 218 of FIG. 5; block 540 of FIG. 8) for the given indexed second type of tone based at least in part on corresponding noise estimates of the selected first type of indexed tones that is nearest the given indexed second type of tone in the received signal (See page 15, line 25, to page 16, line 2; and page 21, lines 3-9).

E. Claim 60

Claim is directed to a communication receiver (10 in FIG. 1; 100 in FIG. 4; 304 in FIG. 6) configured to compute beamforming for signals in a communication system. The receiver comprises means for receiving a signal over a communication channel (12, 14, in FIG. 1; 102, 104, 106 in FIG. 4; 312, 314, 316, 326 in FIG. 6) (See page 20, lines 13-14),

wherein the signal comprises a plurality of tones, the plurality tones comprising a plurality of a first type of tones and a plurality of second type of tones (See page 7, lines 11-17; see also FIGS. 2 and 3 for examples of tones and page 7, lines 18-29; page 8, lines 3-6). The communication receiver also includes means for determining a channel estimate (22 in FIG. 1; 126 in FIG. 4; 202 in FIG. 5; 326, 330 in FIG. 6) for the communication channel (page 8, lines 18-20; page 10, lines 2-10; page 17, lines 22-31). The communication receiver also includes means (36 in FIG. 1; 132 in FIG. 4; 204, 206, 208, 210, 212 in FIG. 5; 326, 330 in FIG. 6) for estimating noise for a plurality of the first type of tones in the received signal (Page 11, lines 2-19; page 13, lines 8-11; page 17, lines 22-29). The communication receiver also includes means for computing beamforming (140 in FIG. 4; 218 in Fig. 5; 326, 330 in FIG. 6) for at least one of a plurality of the second type of tones based on the determined channel estimate and the estimated noise of at least one of the plurality of the first type of tones that is nearest a respective one of the plurality of the second type of tones in the received signal (page 11, line 24, to page 12, line 2; page 15, line 20, to page 16, line 4; page 17, lines 22-25 and page 18, lines 2-5).

F. Claim 61

Claim 61 is directed to a communication receiver (10 in FIG. 1; 100 in FIG. 4; 304 in FIG. 6) according to claim 60, which further comprises means (206 in FIG. 5) for computing a first indication of difference between a first one of the first type of tones in one burst relative to the first one of the first type of tones in a preceding burst (page 13, lines 13-17). The receiver also includes means (210 in FIG. 5) for computing a second indication of variance and correlation of the first indication (page 14, lines 14-15, and lines 26-27). The receiver also includes means (212 in FIG. 5) for averaging the second indication over time to define the estimated noise of the at least one of the plurality of the first type of tones (page 15, lines 1-17).

G. Claim 63

Claim 63 is directed to a communication receiver (10 in FIG. 1; 100 in FIG. 4; 304 in FIG. 6) according to claim 60, which further comprises means (132 in FIG. 4; 208 in FIG. 5; 326 in FIG. 6) for indexing the plurality of first type of tones (Page 13, lines 25-29). The system also includes means (140 in FIG. 4; 220 in FIG. 5; 326 in FIG. 6) for indexing the plurality of second type of tones (Page 15, lines 15-24). The system also includes means (140 in FIG. 4; 216 in FIG. 5; 326 in FIG. 6) for selecting the at least one of the plurality of the first type of indexed tones that is nearest a given indexed second type of tone in the signal. The means for computing beamforming (140 in FIG. 4; 218 in Fig. 5; 326, 330 in FIG. 6) computes the beamforming for the given indexed second type of tone based at least in part on the noise estimation of the selected first type of indexed tones that is nearest the given indexed second type of tone in the signal (See page 11, lines 26-27; page 15, lines 17-24, page 17, line 22, to page 18, line 4).

H. Claim 65

Claim 65 is directed to a communication receiver (10 in FIG. 1; 100 in FIG. 4; 304 in FIG. 6) that comprises a tone extractor (32 in FIG. 1; 126 in FIG. 4; 202 in FIG. 5, 326, 330 in FIG. 6) configured to extract a plurality of first type of tones from a signal received over a communication channel (page 10, lines 15-18; page 13, lines 2-6; page 17, lines 22-27). A channel estimator (22 in FIG. 1; 126 in FIG. 4; 202 in FIG. 5; 326, 330 in FIG. 6) is configured to provide a channel estimate for the communication channel (page 8, lines 18-20; page 10, lines 2-10; page 17, lines 22-31). A noise estimator (36 in FIG. 1; 132 in FIG. 4; 204, 206, 208, 210, 212 in FIG. 5; 326, 330 in FIG. 6) is configured to estimate noise for the extracted plurality of the first type of tones and provide a noise estimate for the plurality of the first type of tones (Page 11, lines 2-19; page 13, lines 8-11; page 17, lines 22-29). A beamformer (140 in FIG. 4; 218 in Fig. 5; 326, 330 in FIG. 6) is configured to compute beamforming for a plurality of a second type of tones in the received signal based on the channel estimate and based on the noise

estimate of the extracted plurality of the first type of tones that are nearest to respective ones of the second type of tones in the received signal (page 11, line 24, to page 12, line 2; page 15, line 20, to page 16, line 4; page 17, lines 22-25 and page 18, lines 2-5).

I. Claim 66

Claim 66 is directed to a communication receiver (10 in FIG. 1; 100 in FIG. 4; 304 in FIG. 6) according to claim 65, wherein the noise estimator comprises an index (132 in FIG. 4; 208 in FIG. 5; 326 in FIG. 6) operative to index through the plurality of the first type of tones (Page 13, lines 25-29). A first noise estimation portion (206 in FIG. 5) is operative to compute a first indication of a difference between an indexed tone of the plurality of the first type of tones in one burst relative to an indexed tone of the plurality of the first type of tones in a preceding burst (page 13, lines 13-17). A second noise estimation portion (210 in FIG. 5) is operative to compute a second indication of variance and correlation of the first indication computed by the first noise estimation portion (page 14, lines 14-15, and lines 26-27). A time averager (212 in FIG. 5) is operative to average the second indication computed by the second noise estimation portion over time to define the corresponding noise estimates for the plurality of the first type of tones (page 15, lines 1-17).

J. Claim 68

Claim 68 is directed to a communication receiver (10 in FIG. 1; 100 in FIG. 4; 304 in FIG. 6) according to claim 66, which further comprises an indexing function (140 in FIG. 4; 220 in FIG. 5; 326 in FIG. 6) that selects an indexed second type of tone from the plurality of the second type of tones for which a current beamforming computation is to be performed (Page 15, lines 15-24). A noise selection function (140 in FIG. 4; 216 in FIG. 5; 326 in FIG. 6) operative to select one of the plurality of the first type of tones nearest to the indexed second type of tone, the respective beamforming computation for the indexed second type of tone employing the computed noise estimation for the

selected one of the plurality of the first type of tones(See page 11, lines 26-27; page 15, lines 17-24, page 17, line 22, to page 18, line 4).

K. Claim 73

Claim 73 is directed to a wireless communications system (300 in FIG. 6) that comprises at least one antenna (12 in FIG. 1, 102, 104 in FIG. 4, 312, 314 in FIG. 6) operative to receive a wireless signal over a communication channel and convert the received signal into a corresponding electrical signal . A preprocessing system (14, 18, 22 in FIG. 1; 106, 112, 114, 120 in FIG. 4) is operative to process the electronic signal and convert the corresponding electrical into a digital signal and perform desired preprocessing of the digital signal to provide a preprocessed digital signal in the frequency domain having a plurality of tones, some of the plurality of tones being of a first type and others of the plurality of tones being of a second type, the tones of the first type having a fewer number of tones than the tones of the second type (Page 5, line 28, to page 6, line 11; page 8, lines 11-14; page 9, line 20, to page 10, line 10). A channel estimator (22 in FIG. 1; 126 in FIG. 4; 202 in FIG. 5; 326, 330 in FIG. 6) is operative to characterize the communication channel and provide a channel estimate thereof (page 8, lines 18-20; page 10, lines 2-10; page 17, lines 22-31). A noise estimator (36 in FIG. 1; 132 in FIG. 4; 204, 206, 208, 210, 212 in FIG. 5; 326, 330 in FIG. 6) is operative to estimate noise for tones of the preprocessed digital signal of the first type and to provide an indication of estimated noise for the tones of the first type (Page 11, lines 2-19; page 13, lines 8-11; page 17, lines 22-29). A beamformer (140 in FIG. 4; 218 in Fig. 5; 326, 330 in FIG. 6) is operative to perform beamforming computations for tones of the first preprocessed digital signal of the second type, the beamforming computations employing the channel estimate and the indication of estimated noise for a tone of the first type nearest each respective tone of the second type (page 11, line 24, to page 12, line 2; page 15, line 20, to page 16, line 4; page 17, lines 22-25 and page 18, lines 2-5).

VII. <u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

A. Whether claims 54, 56, 57, 59, 60, 62, 63, 65, 67,68, and 70-74 are unpatentable under 35 U.S.C. §103(a) Youssefmir.

B. Whether claims 55, 58, 61, 64, 66 and 69 are unpatentable under 35 U.S.C. 103(a) over Youssefmir in further view of to Raleigh.

VIII. <u>ARGUMENT</u>

To reject claims in an application under section 103 of Title 35, an examiner must show an unrebutted *prima facie* case of obviousness. See *In re Deuel*, 51 F.3d 1552, 1557, 34 U.S.P.Q.2d 1210, 1214 (Fed. Cir. 1995). In the absence of a proper prima facie case of obviousness, an applicant who complies with the other statutory requirements is entitled to a patent. See *In re Oetiker*, 977 F.2d 1443, 1445, 24 U.S.P.Q.2d 1443, 1444 (Fed. Cir. 1992).

A rejection based on section 103 must rest on a factual basis, and these facts must be interpreted without hindsight reconstruction of the invention from the prior art. It is improper to resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in its factual basis. See *In re Warner*, 379 F.2d 1011, 1017, 154 U.S.P.Q. 173, 178 (CCPA 1967), cert. denied, 389 U.S. 1057, 19 L. Ed. 2d 857, 88 S. Ct. 811 (1968).

The following objective inquiry is to control the analysis under 35 U.S.C. 103:

> "Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, longfelt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented." *KSR v. Teleflex*, 550 U.S. ___, 127 S. Ct. 1727 (2007), citing *Graham v. John Deere Co. of Kansas City*, 383 U. S. 1 at 17–18 (1966).

A. **35 U.S.C. §103(a) Rejection of Claims 54, 56, 57, 59, 60, 62, 63, 65, 67,68, and 70-74 over Youssefmir**

1. **The Obviousness Rejection of Claims 54, 56, 73 and 74**

The Final Action dated contends that claim 54 is obvious over Youssefmir. The various approaches taught in Youssefmir differ fundamentally from the method recited in claim 54. In sharp contrast to Youssefmir, claim 54 recites that beamforming is computed for a second type of tone based on a noise estimate that has been computed for nearest first type of tone where noise has been estimated for each of a plurality of such first type of tones. In claim 56, it is specifically recited that the first type of tones are training tones and that the second type of tones are data tones. Even the broader recitation of claim 54, however, makes an explicit distinction between different types of tones in the received signal and way noise estimates are computed for the second types of tones, which noise estimates are recited as being used to compute beamforming for a first type of tone. As discussed below, Youssefmir fails to provide any disclosure that would enable one of ordinary skill in the art to perform the method of claim 54.

The Final Action contends that Youssefmir contains a disclosure of estimating noise at Col. 8, lines 1-12. Final Action, page 2, last paragraph lines 7-8. However, neither the cited section of Youssefmir, nor Youssefmir more generally, contains any teaching or suggestion of estimating noise in the manner recited in claim 54. In fact, the cited section (Col. 8, lines 1-12) fails to mention that noise estimation is performed on the received signal, and further fails to teach or suggest the particular noise estimation recited in claim 54. See Youssefmir, Col. 8, lines 1-12. Instead, the only reference to interference, which the Final Action contends is noise (See Final Action, page 2, last paragraph lines 5-6), is a general statement that the signal link from the user terminal to the base station is enhanced by mitigating interference based on the manner that the combiner performs uplink spatial processing. See Youssefmir, Col. 7, line 64, through Col. 8, line 4.

The Final Action further alleges that the description at Col. 6, lines 1-22, of Youssefmir supports a position that beamforming is computed based on optimizing an error signal and that the error signal corresponds to the noise estimate. See Final Action, page 2, last line, to page 3, line 1. This representation of the teachings of Youssefmir not only mischaracterizes what is being described in the cited section (Col. 6, lines 1-22) but this interpretation of Youssefmir fails to correspond to what is recited in claim 54. In particular, the embodiment being described at Col. 6, lines 1-22, pertains to FIG. 2A and particular functionality of the adaptive spatial processor 208, which combines received signals and enhances signals by performing compensation for multipath conditions and

providing the interference mitigation. See Youssefmir, Col. 5, line 66, to Col. 6, line 8. Youssefmir provides no further details relevant to claim 54 about how the interference mitigation is achieved by the adaptive spatial processor.

In the Response to Argument's section of the Final Action, the Final Action further states that Youssefmir, at Col. 6, lines 10-20, discloses that "a known training signal may be used to form an 'error' signal. This error signal is used by the system to determine the antenna strategy and determine weighting parameters." Final Action at page 6, lines 4-7. However, nothing in Youssefmir teaches or suggests that the error signal, which can be formed from the known signal or the constructed signal (Youssefmir, at Col. 6, lines 17-19), is a noise estimate on the received signal for each of the plurality of the first type of tones, as is recited in claim 54. Youssefmir, at Col. 6, lines 11-22, states:

> "In one embodiment, a known training sequence of symbols is included in the uplink signal. One version of the embodiment uses a least squares method for the strategy determining…Either the known signal or the constructed reference signal is used to form an error signal, and uplink smart antenna strategy determining determines the uplink weighting parameters that optimize some criterion based on the error. In one embodiment, the criterion is a least squared error criterion."

The Response to Arguments, at page 6, lines 10-12, the Final Action states, "that Col. 6, lines 5-15 [] disclose a training signal embedded within the data signal that is used to produce the error signal (estimate)." As is apparent from the quoted section of Youssefmir above, Youssefmir does not teach that the error signal corresponds to a noise estimate, as recited in claim 54, in which noise is estimated for each of a plurality of first

type of tones. Significantly, the mention in Youssefmir that the known signal or the constructed reference signal is used to form an error signal fails to include any details describing how such signals might be used, such that one of ordinary skill in the art would not be able to perform the method of claim 54 based on what is described in Youssefmir. Instead, Appellant submits that the teaching of Youssefmir relate to a fundamentally different approach where the error signal is an error signal is formed from the entire signal - similar to the approach described in Appellant's Background section at page 2, lines 13-20 of the Present Application.

The Final Action further alleges that an error signal is determined from a received training signal or tone, citing Col. 27, lines 40-50, and Col. 27, line 65, to Col. 28, line 10. Final Action, page 3, lines 1-2. This conclusion relies upon a faulty premise that the error signal corresponds to a noise estimate, as recited in claim 54. As discussed above, however, nothing in Youssefmir supports the conclusion that the error signal corresponds to a noise estimate that has been estimated for a received signal for each of a plurality of first type of tones. Moreover, the discussion in Youssefmir relating to the use of a pilot tone or a training signal in response to a polling signal (See Youssefmir at Col. 27, lines 27-48) does not include any description of how the pilot tone or training signal are utilized, but instead simply identifies that the training signal or pilot tone are alternative ways to provide the responses from the user terminals for use in determining weighting parameters. Youssefmir at Col. 27, lines 43-46.

The further discussion in Youssefmir at Col. 27, line 66, to Col. 28, line 10, relates to fourth alternative embodiment according to a protocol proposed by Z. Zhang et al. Youssefmir at Col. 27, lines 49-63. In the particular embodiment being described in the cited section of Youssefmir, a remote terminal is disclosed as responding to a polling request with an information request or an unmodulated pilot tone and that such response may be used to update weights. Youssefmir at Col. 27, line 66, to Col. 28, line 2. The Final Action further contends that the error signal, as discussed with respect to the embodiment at Col. 6, lines 1-22, would be determined from the response to the polling request. Final Action, page 3, lines 1-2. Once again, however, this conclusion requires speculation or unsupported assumptions for the teachings of Youssefmir to conclude that an error signal would be determined from either of these types of responses. As discussed herein, however, even this interpretation does not support the conclusion that claim 54 would be obvious in view of Youssefmir.

The Final Action fails to consider the fundamental distinction between estimating noise for the whole known signal (as is taught in Youssefmir) and the approach in claim 54 where noise is estimated for the first type of tones in a signal having both first and second types of tones. There is no basis to conclude that Youssefmir discloses that a noise estimate for using noise estimates for each of a plurality of training tones to compute beamforming for data tones, as is the contention in the Office Action. Final Action, page 9, lines 4-5. This and other contentions in the Final Action thus appear to rest on unsupported speculation by the Examiner and not on the evidence of record. See

In re Warner, 379 F.2d 1011, 1017, 154 U.S.P.Q. 173, 178 (CCPA 1967), cert. denied, 389 U.S. 1057, 19 L. Ed. 2d 857, 88 S. Ct. 811 (1968). The Court of Appeals for the Federal Circuit has also cautioned the Patent Office in a similar situation when they overturned a decision that the prior art rendered the claim obvious as being based on improper hindsight and not based on proper factual evidence. See *In re Rouffet*, 149 F.3d 1350, 47 U.S.P.Q.2d 1453, 1457 (Fed. Cir. 1998).

Significantly, the Final Action admits that "Youssefmir does not specify that the estimates based off a particular training tone are applied to the closest data tone." Final Action, page 3, lines 5-6. The Office Action fails to allege that the estimates being described relate to computing beamforming in the manner recited in claim 54. Instead, the Office Action simply concludes, without identifying any evidence to support such conclusion, that "it would have obvious to one of ordinary skill in the art at the time of this application that the estimates made at a particular instant in time or a particular frequency or a particular tone should be applied to the closest data tones (in time or frequency) for the purpose that the training tone noise estimate (and hence the noise mitigation) would be most accurate for the nearest data tone estimates." See Final Action at page 3, lines 11-14.

It is well settled, that an examiner cannot base a rejection on the assertion that it would have been obvious for a person to do something not suggested in the art because it would give the advantages stated in Applicant's specification. *Panduit Corp. v. Dennison Manufacturing Co.*, 1 U.S.P.Q.2d 1593 (Fed. Cir. 1987). However, the Final

Action purports to do this very thing. As discussed in Appellant's specification, by utilizing the combined noise estimation for a first type of tones that is used for computing beam forming on a second type of tones, the number of computations can be significantly reduced, thereby improving system performance. See, Appellant's Application, at page 5, lines 6-8; and page 9, lines 2-4. There is nothing in Youssefmir that suggests the approach to noise estimation and beamforming that is recited in claim 54, where noise estimates are performed on a first type of tones and beamforming is computed for a second type of tones based on the noise estimate of at least one of the plurality of the first type of tones that is nearest the at least one tone of the plurality of the second type of tones in the received signal. As a result of the failure to teach or suggest the approach recited in claim 54, the approach described in Youssefmir consequently also fails to achieve the benefits of the approach according to claim 54.

Nothing in Youssefmir teaches or suggests that beamforming would be computed for one type of tone based on noise estimated performed for a different type of tone. As discussed above, Youssefmir contains little discussion on the details of the beamforming performed by the system of Fig. 2A or 2B such that the method of claim 54 would not be obvious to one of ordinary skill in the art. Youssefmir glosses over the approach utilized for its beamforming with respect to the description of Fig. 2B. Appellant notes that the Court of Appeals for Federal Circuit has cautioned that knowledge of one ordinary skill in the art does not act as a bridge over gaps in the substance presentation of an obviousness case, but instead is intended to supply an important guarantee of objectivity

in the process. *Okajima v. Bourdeau*, 261 F.3d 1350, 59 U.S.P.Q.2d 1795 (Fed. Cir. 2001). Accordingly, there is insufficient factual evidence conclude that claim 54 is obvious as suggested in the Final Action.

Appellant further submits that the cited section of Youssefmir, at column 8, lines 1 – 12, refers generally to operation of the beam combiner 229 and the beamformer 225, which operate in a manner consistent with traditional prior art approaches disclosed in Youssefmir. For example, in the Background of Youssefmir, at column 1, lines 40 – 52, Youssefmir teaches that prior art smart antenna system include a beamformer that form several fixed beams and a mechanism (*e.g.*, a combiner) for combining one or more beams. Applicant submits that this prior art discussion of the function and purpose of the combiner and beamforming from the Background section of Youssefmir is simply repeated and described with respect to Fig. 2B in Youssefmir at columns 7 and 8. The differences between claim 54 and Youssefmir appears to be due largely to the widely different purpose of Youssefmir, which is to coordinate or synchronize transmission of multiple base stations and multiple receivers. See Youssefmir, Abstract.

Additionally, the Final Action relies on Youssefmir, at Col. 7, line 60, to Col. 8, line 12, to support a contention that a combiner 229 performs channel estimation to compensate for multipath." However, a thorough reading of Youssefmir reveals that the combiner 229 is provided for combining one or more beams from a respective beamformer 225 for uplink signal processing (Youssefmir at Col. 7, line 61, through Col. 8, line 4) and processes the signal to determine weighted versions to transmit one or more

selected beams of the beamformer 225 for downlink signal processing. Col. 8, lines 5-12. To suggest that the combiner performs channel estimation on the received channel is not supported by the teachings of Youssefmir. The contention in the Final Action appears to rest on unsupported speculation and not on the evidence of record. The Court of Appeals for the Federal Circuit has cautioned the Patent Office in a similar situation when they overturned a decision that the prior art rendered the claim obvious as being based on improper hindsight and not based on proper factual evidence. See *In re Rouffet*, *supra*.

In Response to Appellant's previous arguments, the "Examiner contends that Youssefmir does disclose that the combining stage performs spatial processing and combines the beams in a way that mitigates multipath and interference (Col. 8, lines 1-5). Final Action at page 6, lines 1-4. Even the Examiner's own contentions, however, fail to support a rejection of what is actually recited in claim 54; namely, "performing channel estimation on the received signal to provide a channel estimate of the communication channel." Instead, as discussed above, Youssefmir teaches that the combiner simply combines signals according to a set of uplink weighting parameters.

Regarding what is meant by the "error signal" disclosed in Youssefmir, the Response to Arguments Section of the Final Action further states that "the error is only caused by the channel properties or interference (noise) as those are the only things that will act on the signal from when it is transmitted to when it is received. The 'error' is an estimate of what happens to the signal when it travels through the transmission channel." Final Action, page 7, lines 6-12. Appellant submits that this characterization supports the

non-obviousness of claim 54, since it demonstrates that the error signal disclosed in Youssefmir corresponds to noise determined for the signal similar to the approach described in Appellant's Background section at page 2, lines 12-16. This is in sharp contrast to the particular type of noise estimation performed on a first type of tones, in the method of claim 54, which noise estimates are further employed during beamforming computations for at least one tone of a different type.

For these reasons, Appellant submits that the method of claims 54, 56, 73 and 74 would not be obvious to one of ordinary skill in the art in view of Youssefmir. Accordingly, Appellant respectfully requests that the rejection of claims 54, 56, 73 and 74 be withdrawn.

2. <u>The Obviousness Rejection of Claims 57, 59, 63 and 68</u>

Regarding claim 57, the Final Action contends that the received tones inherently require indexing and extracting steps for the purpose of being able to retrieve separate and process individual tones (both training and data). Final Action, page 4, lines 5-8. However, the Final Action fails to mention any teaching or suggestion in Youssefmir that might lend credence or support for the rejection of claim 57 with respect to the beamforming. In particular, claim 57 recites that beamforming is computed for the given indexed second type of tone based at least in part on corresponding noise estimates of the selected first type of index tone that is nearest the given index second type of tone in the receive signal. As discussed with respect to claim 54, Youssefmir fails to teach or

suggest the use noise estimates of a first type of tone to compute beamforming for a second type of tone. Consequently, there would be reason to further include the indexing and selection of tones, as further recited in claim 57. Since Youssefmir fails to teach or suggest any use of computing beamforming in the manner recited in claim 57, there is no motivation to further modify the teachings of Youssefmir - apart from improper hindsight gleaned from the present application - to employ the indexing in conjunction with such beamforming as recited in claim 57.

Moreover, it is well settled that an element of a claim is not inherent in disclosure of prior art unless extrinsic evidence clearly shows that missing descriptive matter is necessarily present in the thing described in the reference. *In re Robertson*, 49 U.S.P.Q.2d 1949 (Fed. Cir. 1999). There simply is nothing disclosed in Youssefmir that would require the interrelationship of the indexing of first and second types of tones and selecting the first type of indexed tones (as recited in claim 57), to enable the beamforming to be computed as recited in claim 57.

Assuming *arguendo* that Youssefmir would inherently require some indexing and extraction of tones from the received signal, as discussed with respect to claim 54, there is no suggestion or motivation in Youssefmir for estimating noise for each of the first type of tones extracted from the received signal, such that the beamforming of claim 54 (or claim 60) would be performed for a second type of tones based on such noise estimations. Accordingly, the methods of claims 57 and 63 would not be obvious to one of ordinary skill in the art in view of Youssefmir. There similarly is no basis to conclude

that the extracting and noise estimation recited in claims 59 and 68 would be inherent in the approach taught by Youssefmir.

Regarding claim 63, the Office Action contends that claim 63 is rejected for the same reasons as claim 54. However, in contrast to the rejection of claims 54, claim 63 further recites means for selecting the at least one of the plurality of the first type of index tones that is nearest the given index of the second type of tone and the signal. Thus, even assuming *arguendo* that there would be some indexing mechanism for indexing through the tones and the received signal, there is no basis to conclude from the teachings of Youssefmir any basis or reason for selecting one of the tones that is nearest the given index second type of tone in the signal, as recited in claim 53. As a consequence of failing to suggest such a selection of an indexed tone, there is further no teaching or suggestion in Youssefmir for computing beamforming based at least in part on the noise estimation of the selected first type of index tones that is nearest the given index second type of tone in the signal. Instead, applicant submits that one of ordinary skill in the art would interpret Youssefmir to teach that beamforming occurs for each tone based on noise estimates for each respective tone, as is consistent with the description of Youssefmir. Accordingly, Applicant respectfully requests reconsideration and allowance of claim 63.

Similarly, claim 68 recites that the communication receiver of claim 66 further comprises a noise selection function operative to select one of the plurality of the first type of tones nearest the index of second type of tone that is employed by the

beamforming computation. The Office Action fails to allege any teaching in Youssefmir to relate to the selection of the plurality of tones performed by the noise selection function recited in claim 68, such that no prima facie obviousness case has been presented in the Office Action regarding claim 68. See *In re Oetiker*, 977 F.2d 1443, 1445, 24 U.S.P.Q.2d 1443, 1444 (Fed. Cir. 1992). Instead, similar to claim 57 and 59, the Office Action relies on the same rationale that was utilized to reject claim 54. The rational applied to claim 54, however, is defective with respect to claim 68 since claim 68 recites the noise selection function.

For these reasons, claims 57, 59, 63 and 68 are not obvious over Youssefmir. Accordingly, Appellant respectfully requests that the rejection claims 57, 59, 63 and 68 be withdrawn.

3. The Obviousness Rejection of Claims 60, 62, 65 67, 70 71 and 72

The Final Action contends that claims 60 and 65 are rejected for the same reasons as provided for the rejection of claim 54. Claims 60 and 65 are patentable over Youssefmir for the same reasons as discussed above with respect to claim 54 and claims 57, 59, 63 and 68.

The Final Action further contends that the system of Youssefmir inherently comprises a training tone extractor. Final Action at page 3, lines 15-18. In contrast to this rejection, claim 65 further recites a tone extractor configured to extract a plurality of

first type of tones from a signal received over a communications channel. Since the rejection of claim 54 fail to identify any tone extractor in the teaching of Youssefmir, the Office Action fails to establish a prima facie case of unpatentability of claim 65.

Even assuming *arguendo* that the rationale applied in the Final Action with respect to claims 57, 59, 63 and 68 were further applied to the rejection of claim 65, the teachings of Youssefmir still fails to teach or suggest the communication receiver recited in claim 65. Similar to as discussed with respect to claim 54, there is no teaching or suggestion in Youssefmir that a beamformer would be configured to compute beamforming for a second type of tones in a received signal based on channel estimates and noise estimates of the extracted plurality of first type of tones that is nearest to respective ones of the second type of tones in the received signal as recited in claim 65. Instead, Youssefmir simply glosses over the approach utilized for its beamforming with respect to the various embodiments disclosed in Youssefmir. Accordingly, there is no factual basis in the evidence sufficient to conclude that claim 65 would be obvious to one of ordinary skill in the art. Applicant notes that the Court of Appeals for Federal Circuit has cautioned that knowledge of one ordinary skill in the art does not act as a bridge over gaps in the substance presentation of an obviousness case, but instead is intended to supply an important guarantee of objectivity in the process. *Okajima v. Bourdeau, supra.*

For these reasons, Appellant respectfully requests that the rejection claims 60, 62, 65, 67, 70, 71 and 72 be withdrawn.

B. 35 U.S.C. §103(a) Rejection of Claims 55, 58, 61, 64, 66 and 69 as being made obvious by Youssefmir in view of Raleigh

1. The Obviousness Rejection of Claims 55, 61 and 66

The Final Action admits that Youssefmir does not teach the noise estimation process recited in claim 55. The addition of Raleigh fails to make up for the deficiencies of Youssefmir as discussed above with respect to claim 54.

Regarding claim 55, the Office Action relies on Raleigh for a purported teaching of noise estimation. At page 5, lines 4-5, the Final Action states that, "Raleigh discloses a beamforming system where interference (noise) is estimated in order to optimize beamforming." Citing Raleigh, at Col. 8, lines 10 – 45. The Final Action further contends that the estimation of received interference plus noise signal sequence of the equalization strategy (disclosed at Col. 15, lines 25-39, of Raleigh) corresponds to the noise estimation process recited in claim 55.

In sharp contrast to the contention in the Final Action, the various embodiments disclosed in Raleigh at Col 8, lines 25-45, Col. 156 lines 25-39, as well as Raleigh more generally - alone or in combination with Youssefmir - fail to teach or suggest the particular channel estimation, noise estimation and beamforming recited in claim 55, which depends from claim 54. Instead, as described in the Supplement 1 section of Raleigh, Raleigh discloses that the noise estimate is computed for each data subcarrier; namely, based on the received signal, the channel estimate and an estimate of the transmitted data at each data subcarrier. See Raleigh at Col. 15, line 61, through Col. 17,

line 28. This is in sharp contrast to the noise estimation recited in claim 55, which is performed on each of the plurality of the first type of tones, and in which the beamforming is computed for at least one of the plurality of the second type of tones (claim 54). Moreover, the Office Action appears to mischaracterize Raleigh by alleging that a noise estimator computes the difference between the received training signal and the previous training signal. See Office Action at Page 5. In fact, the only mention of any training signals in Raleigh occurs specifically at: Col. 3, line 19; Col. 4, line 65; Col. 7, line 44; and Col. 9, line 25. None of these sections in Raleigh that describe training signals, however, supports the allegations in the Office Action relating to claim 55. As a result of the failure to teach or suggest the approach recited in claim 55, the approach described in Youssefmir consequently also fails to achieve the benefits of the approach, such as reduced computation and performance improvements discussed with respect to claim 54.

Additionally, claim 55 recites two independent indications that are computed: namely; (1) a first indication of a difference between a first one of a first type of tones in one burst relative to the first one of the first type of tones in a proceeding burst; and (2) a second indication of variance and correlation which is of the first indication. These indications are independent in the sense that they are separate computations, *e.g.*, the first indication is computed and second is computed from the first. In further contrast to what is taught by Raleigh, claim 55 recites that the second indication is averaged over time to provide an average indication of noise that defines the noise estimate for at least one of

the plurality of the first type of tones (See claim 54). It is based on such noise estimation for each of the plurality of the first type of tones and the channel estimates that the beamforming (of claim 54) is computed for at least one tone of the second type. Since Raleigh fails to teach or suggest noise estimation, as recited in claim 55, (Raleigh instead teaching estimating noise based on the received signal, the channel estimate and an estimate of the transmitted data at each subcarrier), the purported combination of Raleigh and Youssefmir consequently also fails to teach or suggest claim 55. See Raleigh at Col. 15, line 61, through Col. 17, line 28.

For the reasons discussed above, claims 55, 58, 61, 64, 66 and 69 would not be obvious to one of ordinary skill in the art over Youssefmir in view of Raleigh. Accordingly, Appellant respectfully requests that the rejection claims 55, 58, 61, 64, 66 and 69 be withdrawn.

IX. APPENDICES

The first attached Appendix contains a copy of the claims on appeal.

The second and third Appendices have been included to comply with statutory requirements.

No additional fees should be due for this Amended Brief. In the event any fees are due in connection with the filing of this document, the Commissioner is authorized to charge those fees to Deposit Account No. 20-0668 of Texas Instruments Incorporated.

Respectfully submitted,

I hereby certify that this correspondence is being transmitted to the U.S. Patent and Trademark Office via electronic filing on October 26, 2007.

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Claims Appendix

1-53 (Cancelled)

54. (Previously Presented) A method for computing beamforming for signals in a communication system comprising:

receiving a signal having a plurality of tones over a communication channel, some of the plurality of tones being of a first type and some of the plurality of tones being of a second type;

performing channel estimation on the received signal to provide a channel estimate of the communication channel;

estimating noise on the received signal for each of a plurality of the first type of tones to provide a corresponding noise estimate for each of the plurality of the first type of tones; and

computing beamforming for at least one tone of a plurality of the second type of tones based on the channel estimate and based on the noise estimate of at least one of the plurality of the first type of tones that is nearest the at least one tone of the plurality of the second type of tones in the received signal.

55. (Previously Presented) A method according to claim 54, wherein the estimating noise further comprises:

computing a first indication of difference between a first one of the first type of tones in one burst relative to the first one of the first type of tones in a preceding burst;

computing a second indication of variance and correlation of the first indication; and

averaging the second indication over time to provide an average indication of noise that defines the noise estimate for at least one of the plurality of the first type of tones.

56. (Previously Presented) A method according to claim 54, wherein

the received signal is a multi-carrier signal;

the first type of tones are training tones; and

the second type of tones are data tones.

57. (Previously Presented) A method according to claim 54, further comprising:

indexing the plurality of the first type of tones;

indexing the plurality of the second type of tones;

selecting at least one of the plurality of the first type of indexed tones that is nearest a given indexed second type of tone in the received signal; and

the beamforming being computed for the given indexed second type of tone based at least in part on corresponding noise estimates of the selected first type of indexed tones that is nearest the given indexed second type of tone in the received signal.

58. (Previously Presented) A method according to claim 54, wherein the computing beamforming further comprises:

computing at least one of soft decisions and noise to signal ratio estimates for the at least one of the plurality of the second type of tones.

59. (Previously Presented) A method according to claim 54, wherein the performing channel estimation further comprises:

extracting the plurality of the first type of tones from the received signal, the channel estimation being performed based on the plurality of the first type of tones extracted from the received signal;

the estimating noise being performed for each of the plurality of the first type of tones extracted from the received signal.

60. (Previously Presented) A communication receiver configured to compute beamforming for signals in a communication system comprising:

means for receiving a signal over a communication channel, wherein the signal comprises a plurality of tones, the plurality tones comprising a plurality of a first type of tones and a plurality of second type of tones;

means for determining a channel estimate for the communication channel;

means for estimating noise for a plurality of the first type of tones in the received signal; and

means for computing beamforming for at least one of a plurality of the second type of tones based on the determined channel estimate and the estimated noise of at least one of the plurality of the first type of tones that is nearest a respective one of the plurality of the second type of tones in the received signal.

61. (Previously Presented) A communication receiver according to claim 60, further comprising:

means for computing a first indication of difference between a first one of the first type of tones in one burst relative to the first one of the first type of tones in a preceding burst;

means for computing a second indication of variance and correlation of the first indication; and

means for averaging the second indication over time to define the estimated noise of the at least one of the plurality of the first type of tones.

62. (Previously Presented) A communication receiver according to claim 60, wherein

the signal is a multiple carrier signal;

the first type of tones are training tones; and

the second type of tones are data tones.

63. (Previously Presented) A communication receiver according to claim 60, further comprising:

means for indexing the plurality of first type of tones;

means for indexing the plurality of second type of tones;

means for selecting the at least one of the plurality of the first type of indexed tones that is nearest a given indexed second type of tone in the signal; and

the means for computing beamforming computes the beamforming for the given indexed second type of tone based at least in part on the noise estimation of the selected first type of indexed tones that is nearest the given indexed second type of tone in the signal.

64. (Previously Presented) A communication receiver according to claim 60, wherein the beamforming further comprises at least one of soft decisions and noise to signal ratio estimates computed by the means for computing beamforming for the at least one of the plurality of the second type of tones.

65. (Previously Presented) A communication receiver comprising:

a tone extractor configured to extract a plurality of first type of tones from a signal received over a communication channel;

a channel estimator configured to provide a channel estimate for the communication channel;

a noise estimator configured to estimate noise for the extracted plurality of the first type of tones and provide a noise estimate for the plurality of the first type of tones; and

a beamformer configured to compute beamforming for a plurality of a second type of tones in the received signal based on the channel estimate and based on the noise estimate of the extracted plurality of the first type of tones that are nearest to respective ones of the second type of tones in the received signal.

66. (Previously Presented): A communication receiver according to claim 65, wherein the noise estimator comprises:

an index operative to index through the plurality of the first type of tones;

a first noise estimation portion operative to compute a first indication of a difference between an indexed tone of the plurality of the first type of tones in one burst relative to an indexed tone of the plurality of the first type of tones in a preceding burst;

a second noise estimation portion operative to compute a second indication of variance and correlation of the first indication computed by the first noise estimation portion; and

a time averager operative to average the second indication computed by the second noise estimation portion over time to define the corresponding noise estimates for the plurality of the first type of tones.

67. (Previously Presented) A communication receiver according to claim 65, wherein

the received signal is a multiple carrier signal;

the first type of tones are training tones; and

the second type of tones are data tones.

68. (Previously Presented) A communication receiver according to claim 66, further comprising:

an indexing function that selects an indexed second type of tone from the plurality of the second type of tones for which a current beamforming computation is to be performed; and

a noise selection function operative to select one of the plurality of the first type of tones nearest to the indexed second type of tone, the respective beamforming computation for the indexed second type of tone employing the computed noise estimation for the selected one of the plurality of the first type of tones.

69. (Previously Presented) A communication receiver according to claim 65, wherein the beamformer is further configured to compute at least one of soft decisions and noise to signal ratio estimates for at least some of the second type of tones.

70. (Previously Presented) A communication receiver of claim 65 being implemented as part of an application specific integrated circuit.

71. (Previously Presented) A communication receiver of claim 65 being implemented as executable instructions programmed in a digital signal processor.

72. (Previously Presented) A communication receiver of claim 65, wherein the plurality of the first type of tones are interspersed throughout the received signal and fewer in number than the plurality of the second type of tones in the received signal.

73. (Previously Presented) A wireless communications system, comprising:

at least one antenna operative to receive a wireless signal over a communication channel and convert the received signal into a corresponding electrical signal;

a preprocessing system operative to process the electronic signal and convert the corresponding electrical into a digital signal and perform desired preprocessing of the digital signal to provide a preprocessed digital signal in the frequency domain having a plurality of tones, some of the plurality of tones being of a first type and others of the plurality of tones being of a second type, the tones of the first type having a fewer number of tones than the tones of the second type;

a channel estimator operative to characterize the communication channel and provide a channel estimate thereof;

a noise estimator operative to estimate noise for tones of the preprocessed digital signal of the first type and to provide an indication of estimated noise for the tones of the first type; and

a beamformer operative to perform beamforming computations for tones of the first preprocessed digital signal of the second type, the beamforming computations employing the channel estimate and the indication of estimated noise for a tone of the first type nearest each respective tone of the second type.

74. (Previously Presented) The system of claim 73, wherein the tones of the preprocessed digital signal conforming to a multiple carrier modulation technique in which the first type of tones corresponds to training tones and the second type of tones corresponds to data tones.

Evidence Appendix

None

Related Proceedings Appendix

None